

**Problem Set 3**  
CSCE 440/640

**Due dates:** Electronic submission of the pdf file of this homework is due on **9/21/2016 before 2:50pm** on [ecampus.tamu.edu](http://ecampus.tamu.edu), a signed paper copy of the pdf file is due on **9/21/2014** at the beginning of class.

**Name:** (put your name here)

**Resources.** (All people, books, articles, web pages, etc. that have been consulted when producing your answers to this homework)

On my honor, as an Aggie, I have neither given nor received any unauthorized aid on any portion of the academic work included in this assignment. Furthermore, I have disclosed all resources (people, books, web sites, etc.) that have been used to prepare this homework.

**Signature:** \_\_\_\_\_

Read chapter 4 in the lecture notes and make five insightful comments on perusal. Read chapter 6 in the textbook.

**Problem 1.** (10 points) Exercise 2.24 in the lecture notes.

**Solution.**

**Problem 2.** (20 points) Exercise 2.26 in the lecture notes.

**Solution.**

**Problem 3.** (20 points) Exercise 2.27 in the lecture notes. (a) Design the circuit, (b) prove the correctness of the circuit and (c) show how to create the state.

**Solution.**

**Problem 4.** (20 points)

- (a) Exercise 6.1.1 (a) in the textbook KLM (should read Figure 6.1)
- (b) Exercise 6.1.1 (b) in the textbook KLM

**Solution.**

**Problem 5.** (10 points) Exercise 3.4 in the lecture notes.

**Solution.**

**Problem 6.** (20 points) Consider a system of two quantum bits and a controlled-not gate  $\lambda_{0,1}(X)$  that has the least significant bit as a control bit and acts on the most significant quantum bit. Dispel the myth that the control bit of the controlled-not gate remains unaffected. Specifically, describe the action of the controlled-not gate on the following four states:

$$|0_H\rangle \otimes |0_H\rangle, \quad |0_H\rangle \otimes |1_H\rangle, \quad |1_H\rangle \otimes |0_H\rangle, \quad |1_H\rangle \otimes |1_H\rangle,$$

where

$$|0_H\rangle = \frac{1}{\sqrt{2}}|0\rangle + \frac{1}{\sqrt{2}}|1\rangle \quad \text{and} \quad |1_H\rangle = \frac{1}{\sqrt{2}}|0\rangle - \frac{1}{\sqrt{2}}|1\rangle.$$

Express the result in terms of the  $|0_H\rangle$  and  $|1_H\rangle$  basis.

**Solution.**

**Checklist:**

- Did you add your name?
- Did you disclose all resources that you have used?  
(This includes all people, books, websites, etc. that you have consulted)
- Did you sign that you followed the Aggie honor code?
- Did you solve all problems?
- Did you submit the pdf file resulting from your latex source file on ecampus?
- Did you submit a hardcopy of the pdf file in class?